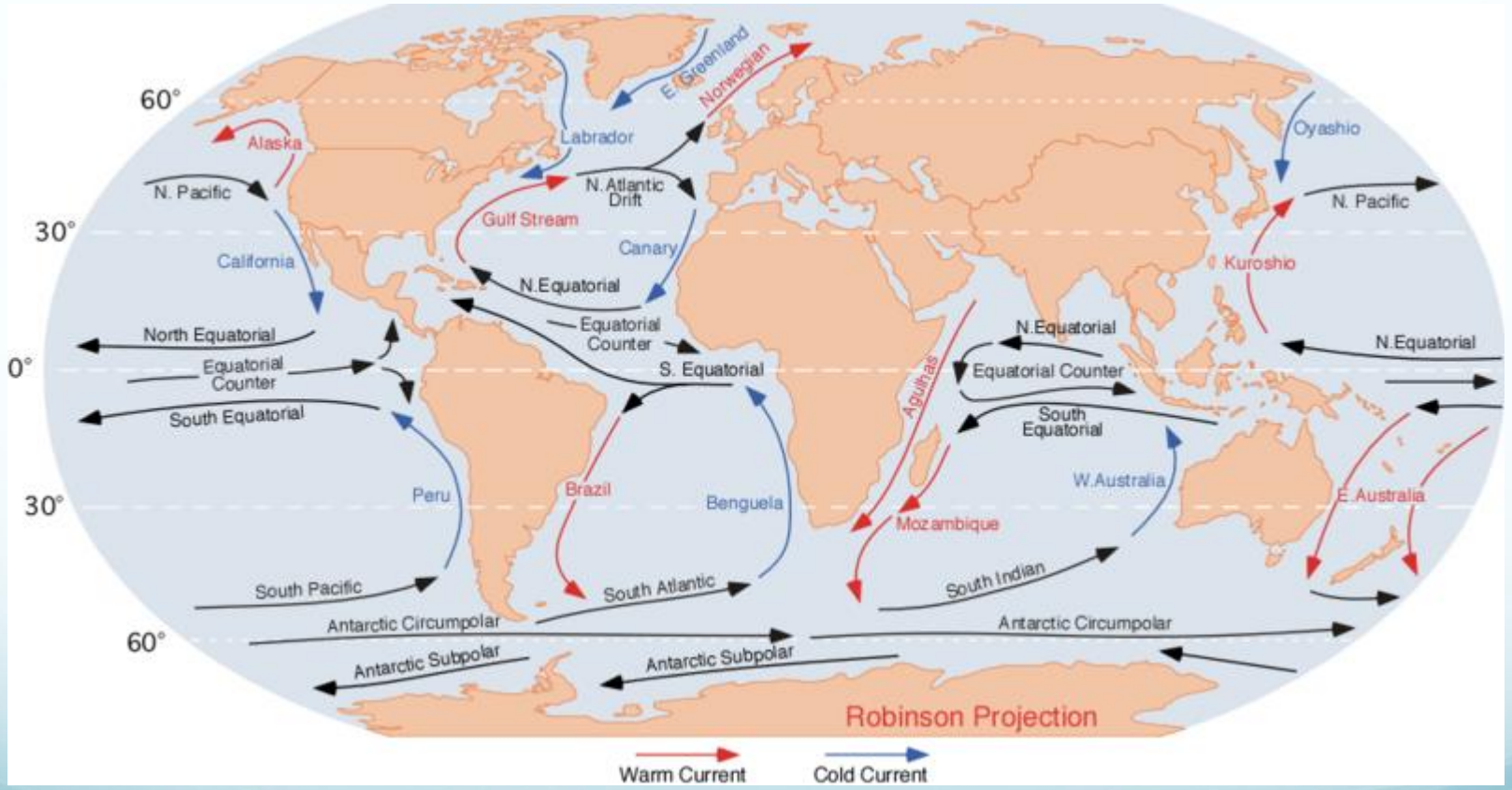
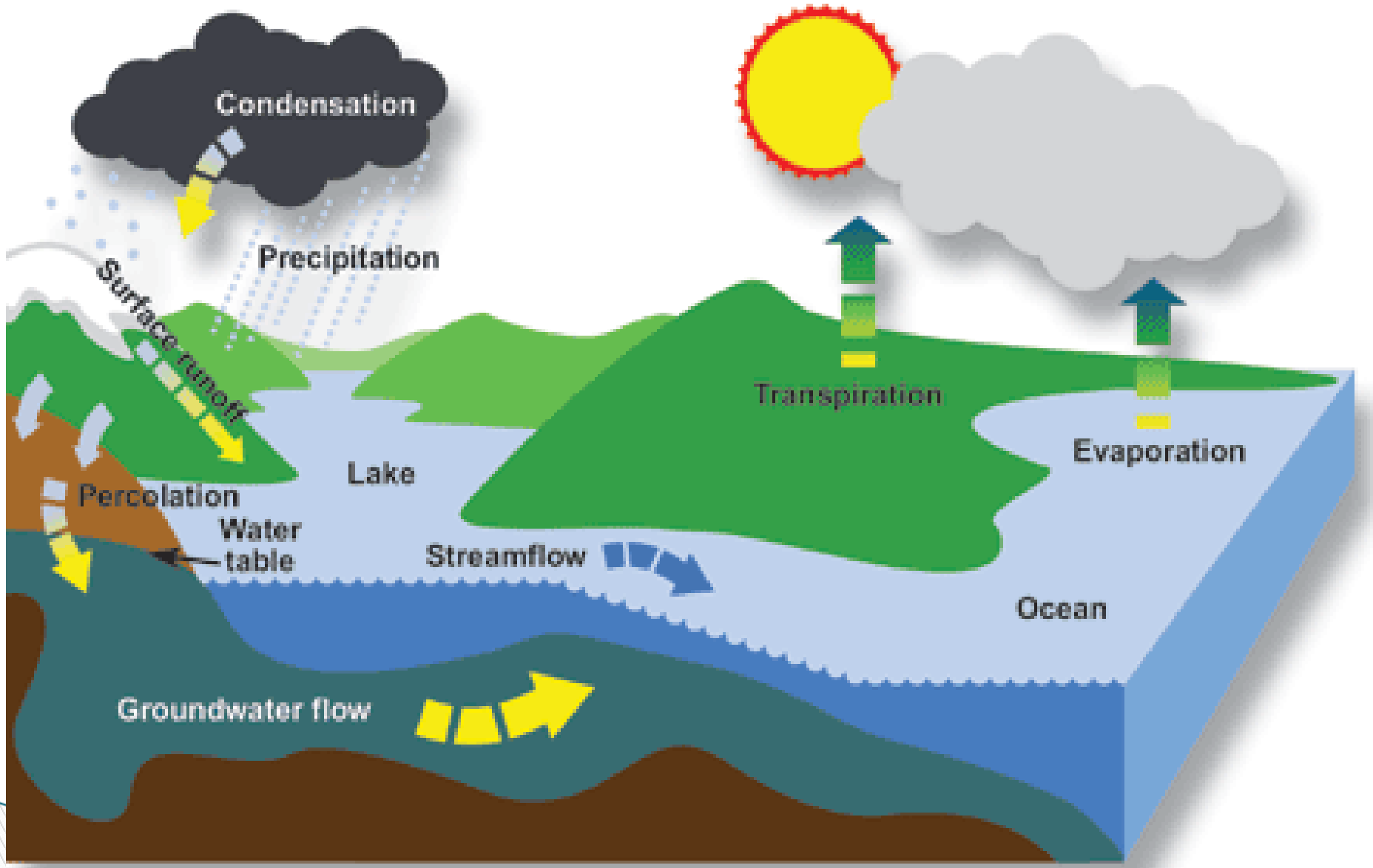
# Oceans and Currents




Condensation
Precipitation
Surface runoff
Transpiration
Evaporation
Lake
Percolation
Water table
Streamflow
Ocean
Groundwater flow

# Evaporation

- Occurs when the sun heats up water and turns it into water vapor (a gas) or steam which travels into the air.

# Condensation

Water vapor in the air gets cold and changes back into liquid, forming clouds.

# Precipitation

- Occurs when so much water has condensed, turned back into liquid, that the air cannot hold it anymore.
- The clouds get heavy and water falls back to the earth in the form of rain, hail, sleet or snow.

# Transpiration

- The process by which moisture is carried through plants and released to the atmosphere. Its the evaporation of water from plants.

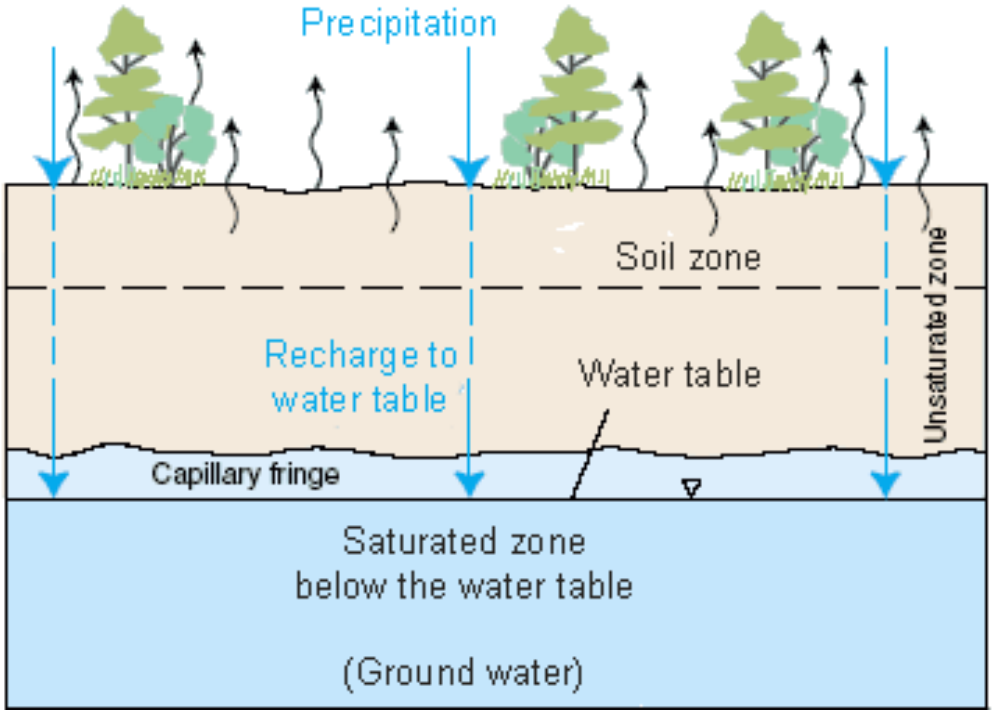
Leaf guttation (Credit: USEPA)

# Runoff

- Water, usually from precipitation, that flows across land and collects in larger bodies of water like rivers, lakes and oceans.

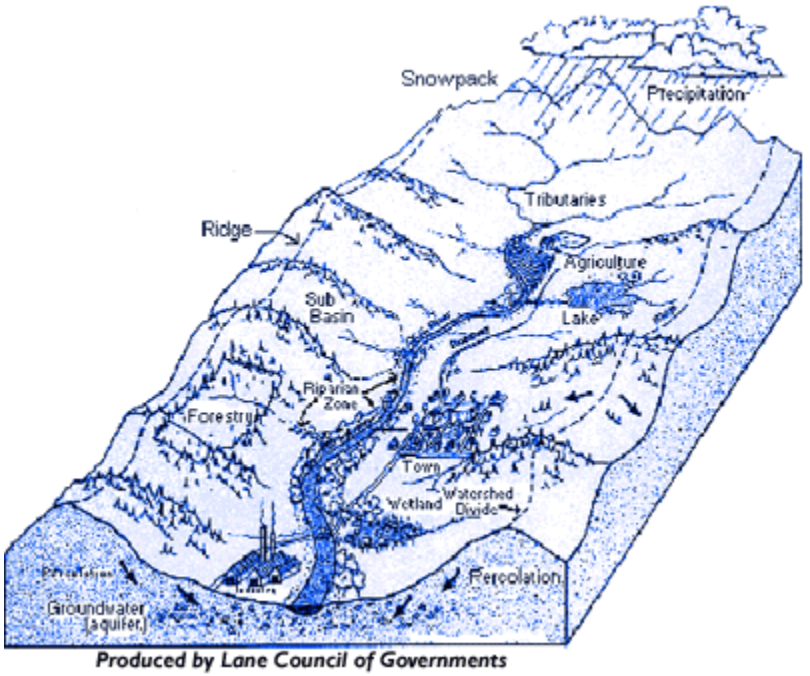
# Infiltration

- the process by which water on the ground surface enters the soil



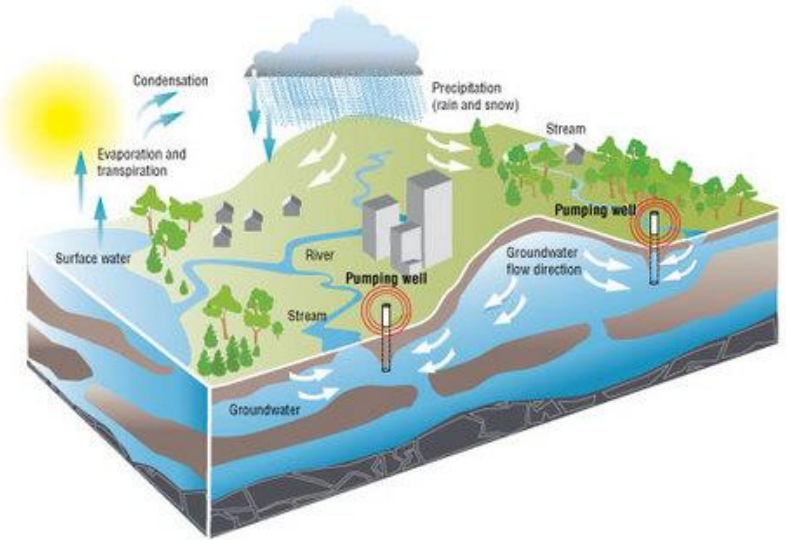
# Watershed

- the area of land where all of the water that is under it or drains off of it goes into the same place



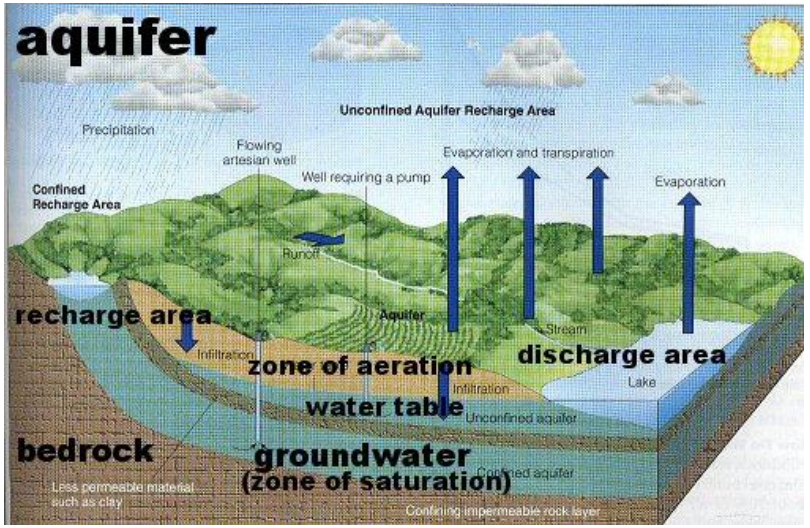
# Ground Water

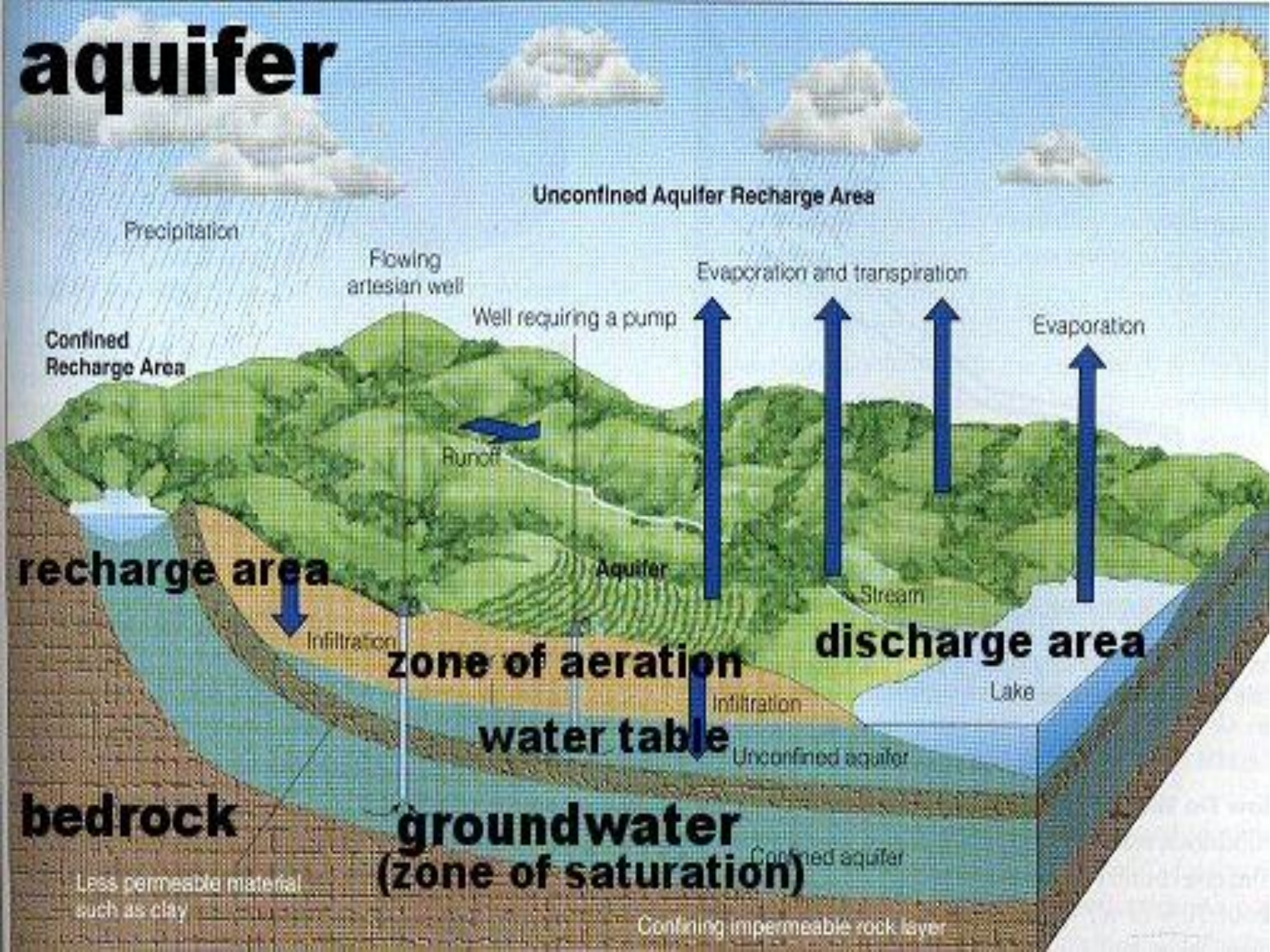
- Water that seeps into the ground and is stored in underground caverns or porous rocks.
- Used to irrigate crops



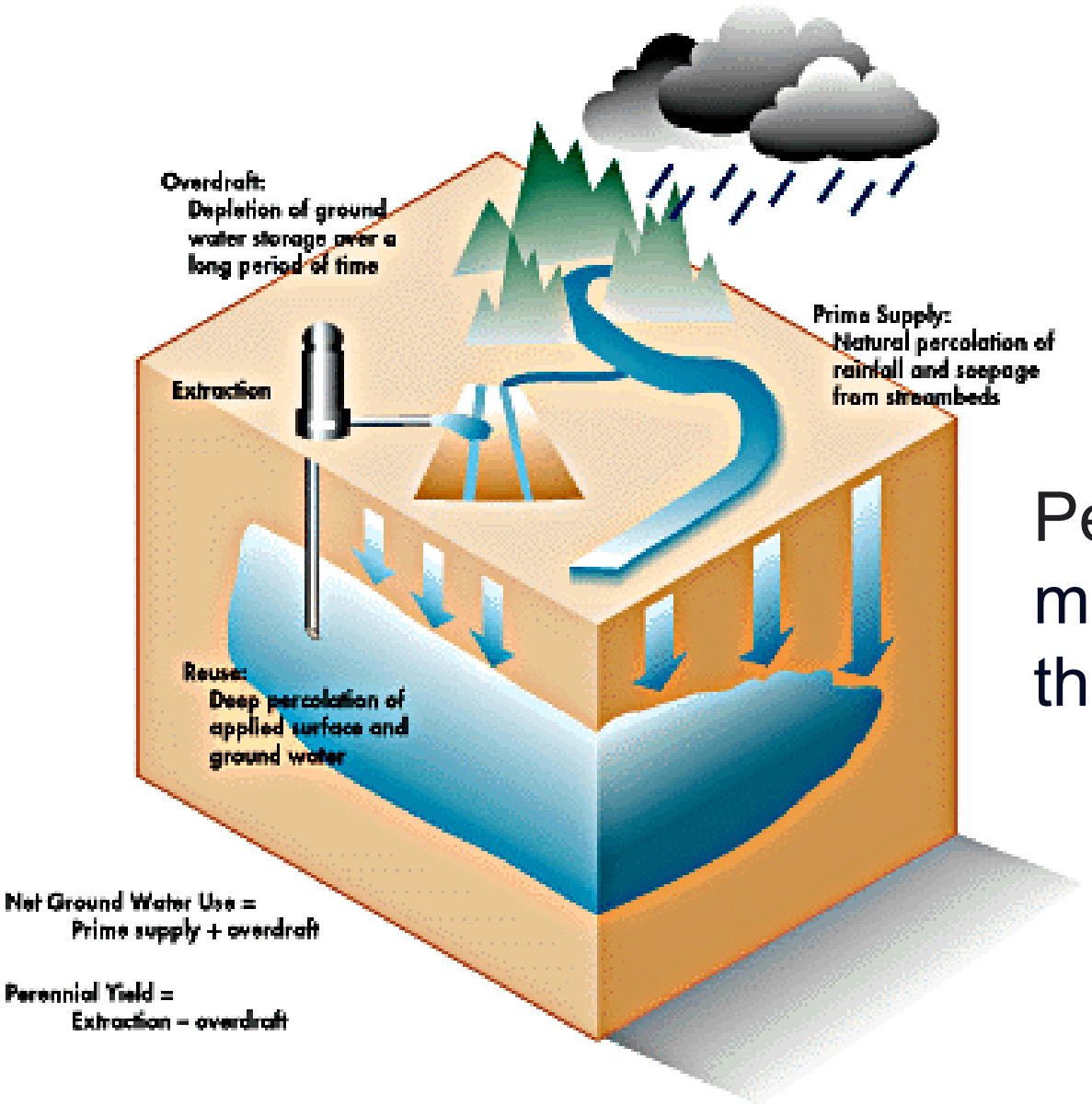
# Aquifer

- Underground river
- Pumped out to supply water to wells and for irrigating crops
- Edwards Aquifer provides water for our area




aquifer
Unconfined Aquifer Recharge Area
Precipitation
Flowing artesian well
Well requiring a pump
Evaporation and transpiration
Evaporation
Confined Recharge Area
Runoff
recharge area
Aquifer
Stream
Infiltration
zone of aeration
discharge area
Lake
Infiltration
water table
Unconfined aquifer
bedrock
groundwater
(zone of saturation)
Confined aquifer
Less permeable material such as clay
Confining impermeable rock layer

# Percolation


Overdraft:
Depletion of ground water storage over a long period of time
Extraction
Prime Supply:
Natural percolation of rainfall and seepage from streambeds
Reuse:
Deep percolation of applied surface and ground water
Net Ground Water Use =
Prime supply + overdraft
Perennial Yield =
Extraction – overdraft

Percolation is the movement of water through the soil itself.

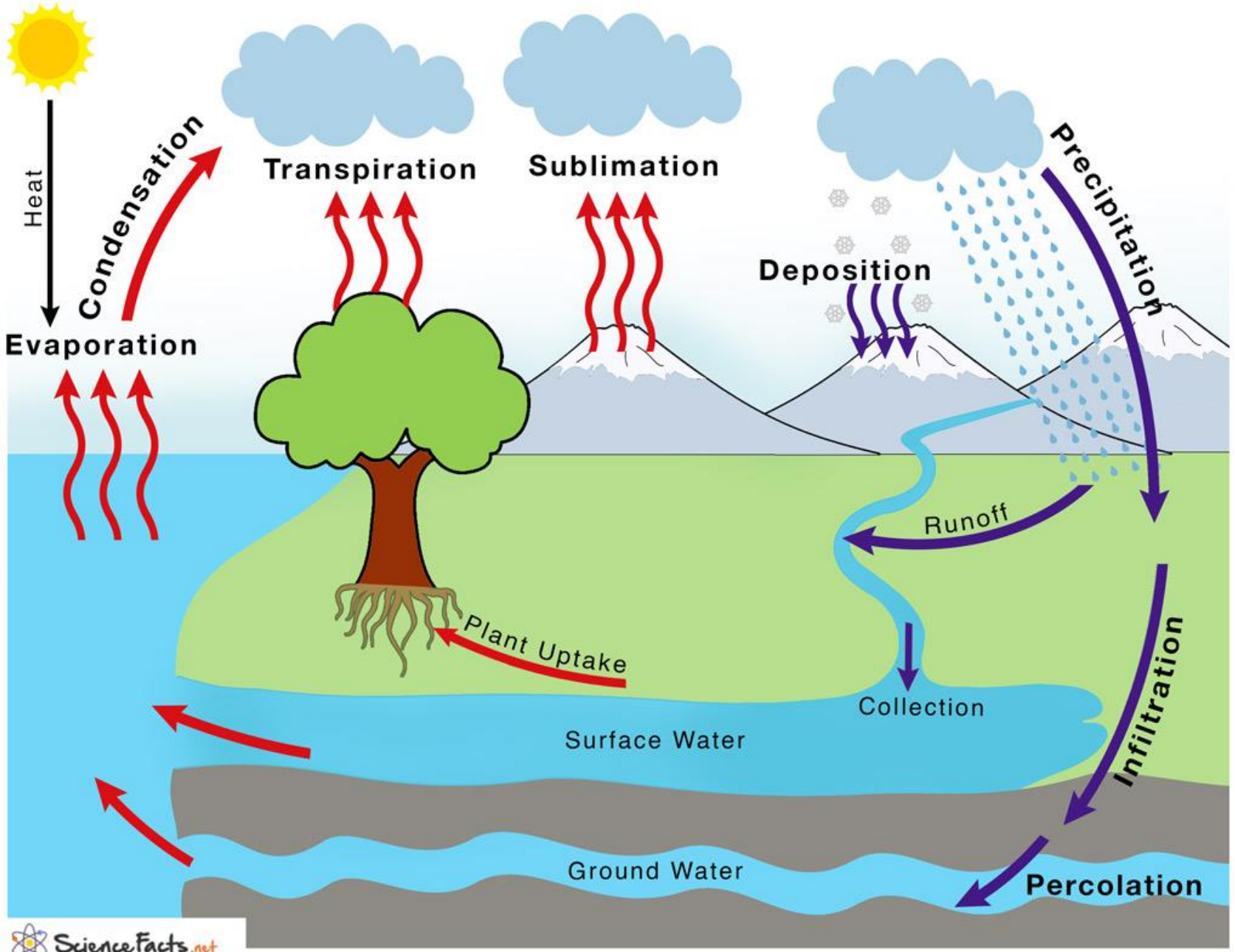
# The Water Cycle

- **Condensation** - water vapor **cools** and changes back into ***liquid*** drops
- **Precipitation** - **rain, snow, sleet or hail** falls from clouds
- **Evaporation** - liquid water changes into water ***vapor (gas)*** in the air.
- **Ground water and runoff (Plant Uptake)** – water **stored underground**, in soil, streams, rivers and oceans.
- **Transpiration** – **living organisms** release water vapor into the atmosphere.

# The Water Cycle

- **Infiltration** - water on the ground surface enters the **soil**
- **Percolation - *movement*** of water through the **soil**.
- **Sublimation -** the process of **snow** and **ice** changing into *water vapor (gas)* in the air without first melting into water.
- **Deposition** - where *water vapor* changes directly into **ice**—such a snowflakes and frost.

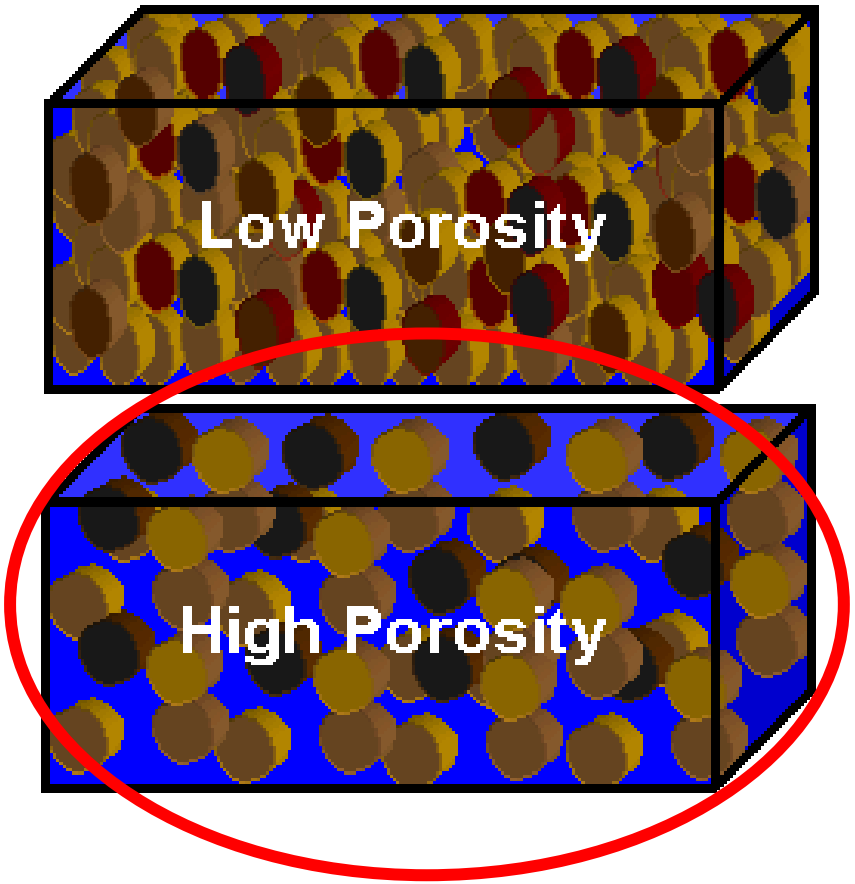
# Water Cycle




ScienceFacts.net

# Sand, Clay, Gravel??

Which type of ground would allow for faster percolation?

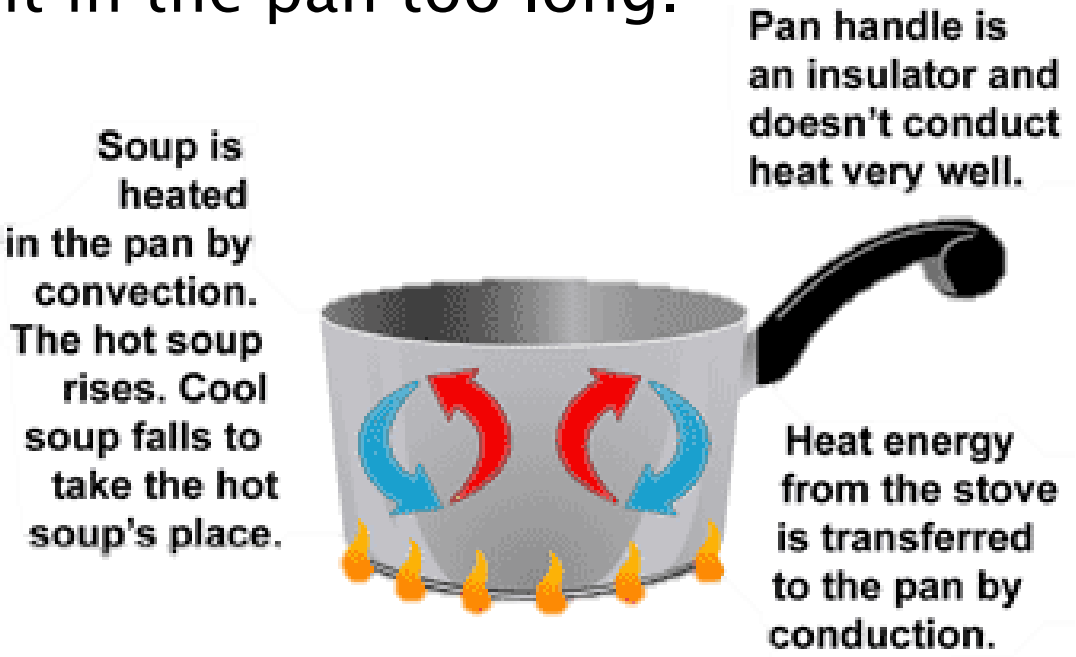


# How things heat up

- **Conduction** – heat is ***transferred*** from the hotter end to the colder end of an object
- **Convection** – process by which heat is transferred by **movement** of a **heated fluid** such as air or water.
- **Radiation** – energy that comes from a **source** and travels through **space** at the speed of light.

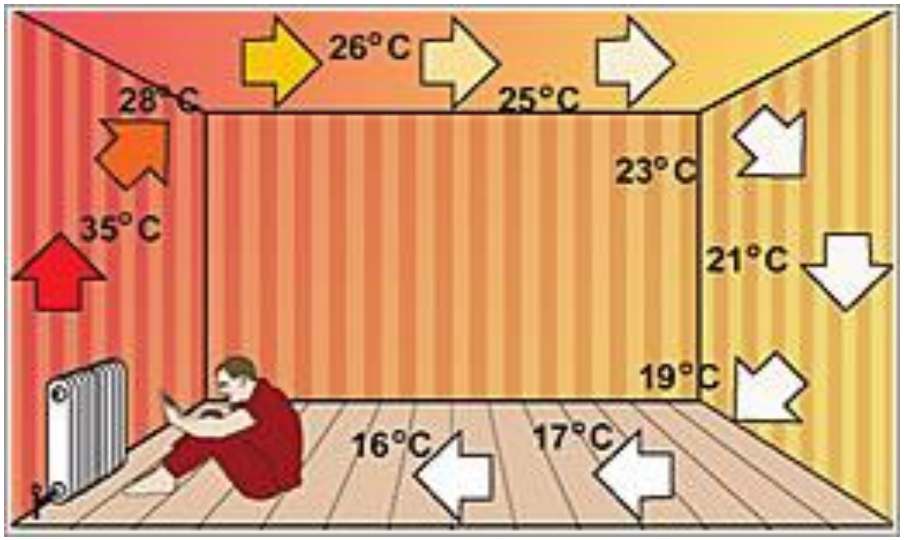
# Conduction

- Transfer of heat by direct contact
- If you put a metal spoon in a saucepan of boiling soup, the heat is transferred to the spoon through conduction. This is why you burn yourself on the spoon if you leave it in the pan too long.


Pan handle is an insulator and doesn't conduct heat very well.
Soup is heated in the pan by convection. The hot soup rises. Cool soup falls to take the hot soup's place.
Heat energy from the stove is transferred to the pan by conduction.

# Convection

- Transfer of heat by the movement of a liquid (water) or gas (air)
- How the tectonic plates move
- How ocean currents transfer heat around the world



# Radiation

- Energy that travels in waves or high speed particles via the electromagnetic spectrum
- Ex/ sun, heater, X-ray machine, radiation for chemotherapy

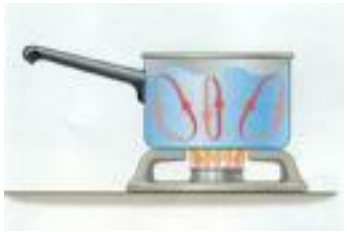
# How things heat up

Look at the images below. Which matches the word?

Conduction

Convection

Convection



Conduction

Radiation

Convection

Radiation

Radiation

Radiation

# Ocean Currents

## What You Need To Know

- All energy on Earth starts with the **Sun**
- Major ocean ***currents*** and ***wind patterns*** create climates
- Solar energy, climate and ocean systems are *interrelated*.
- Oceans can affect the climate of an area.
- Cycles can be modified by nature or **human interaction**

# Oceans and Currents

Recognize that the **Sun provides the energy** that drives convection within the atmosphere and oceans, producing winds and ocean currents.

# Ocean System Cycle

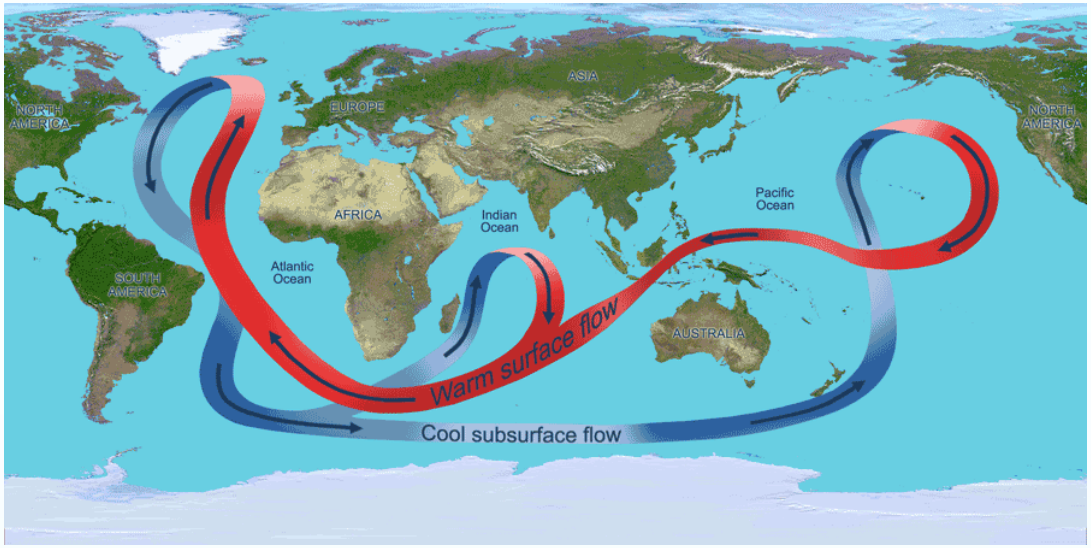
Our **oceans influence weather**, climate and living conditions all around the world.

# What is a system?

- You've heard the term "system".
- Give an example of a system?
- What are the parts of that system?
- How do the parts work together to make the system work?
- Is the system linear or circular?  Or ___?

# Ocean Currents Basics

1. Stream like movements of water in oceans.




2. Heat is transferred around the world by ocean currents through convection.

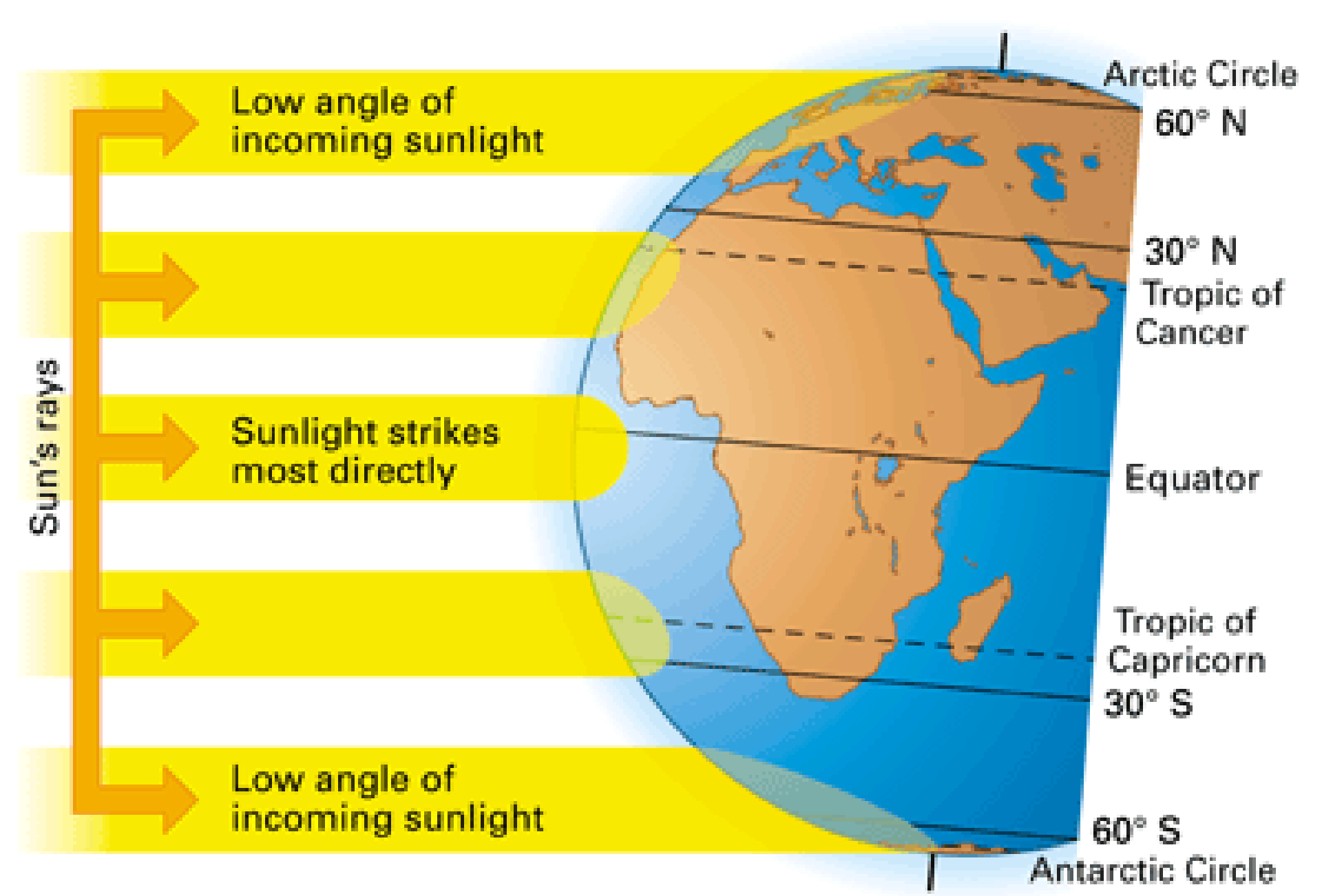
   -Over ½ the heat that reaches the Earth from the Sun is absorbed by the ocean's surface.

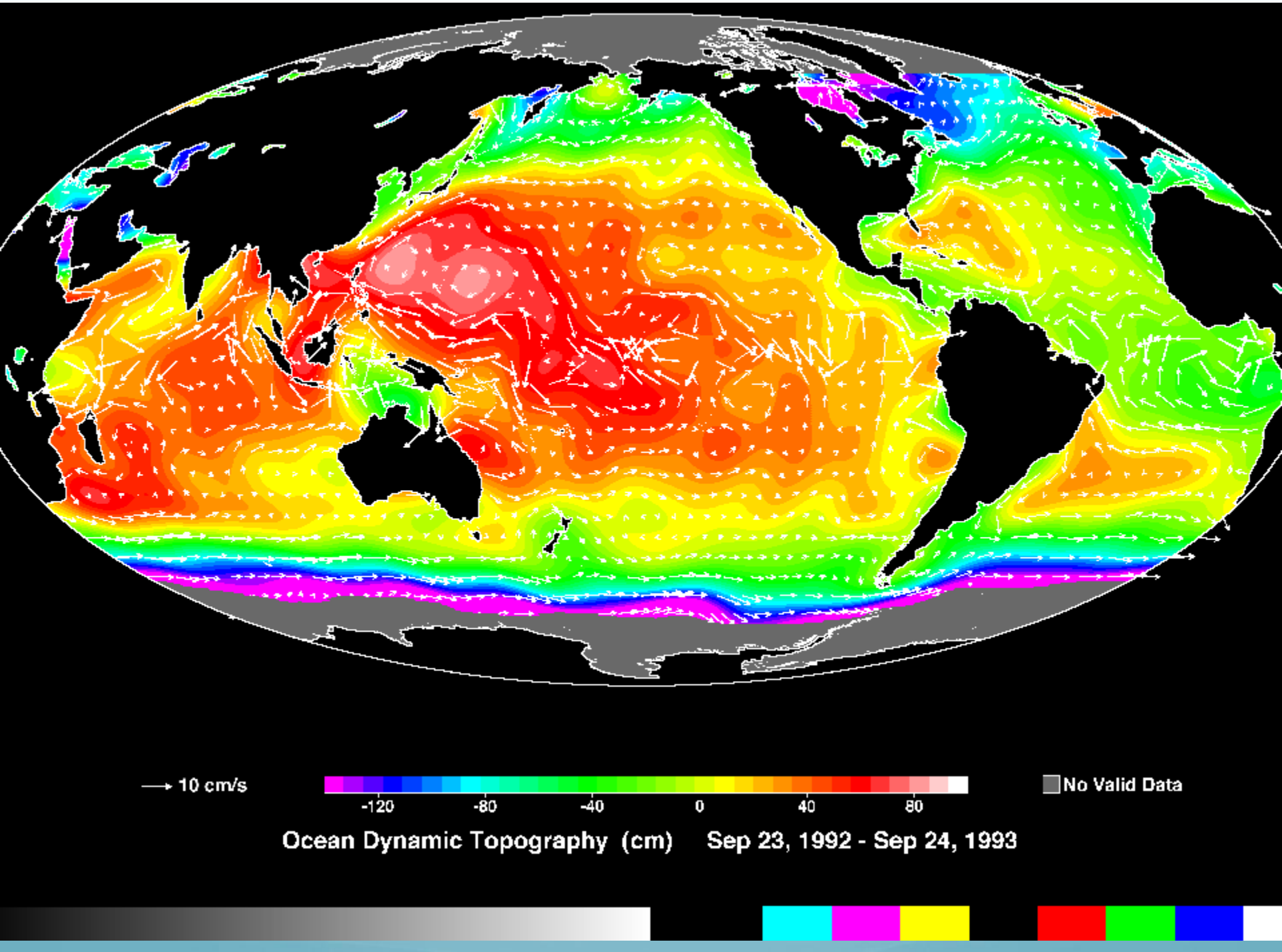
3. This heat affects the Earth's weather and climate.

# WHAT IS AN OCEAN CURRENT?

# Surface Currents

1. Currents at or near the surface of the ocean
2. Affect weather and climate for coastal regions around the world.
    a. Warm currents originate at the Equator and warm coastal areas
    b. Cold currents originate at the Poles and cool coastal areas


Low angle of incoming sunlight
Sun's rays
Sunlight strikes most directly
Low angle of incoming sunlight
Arctic Circle
60° N
30° N
Tropic of Cancer
Equator
Tropic of Capricorn
30° S
60° S
Antarctic Circle

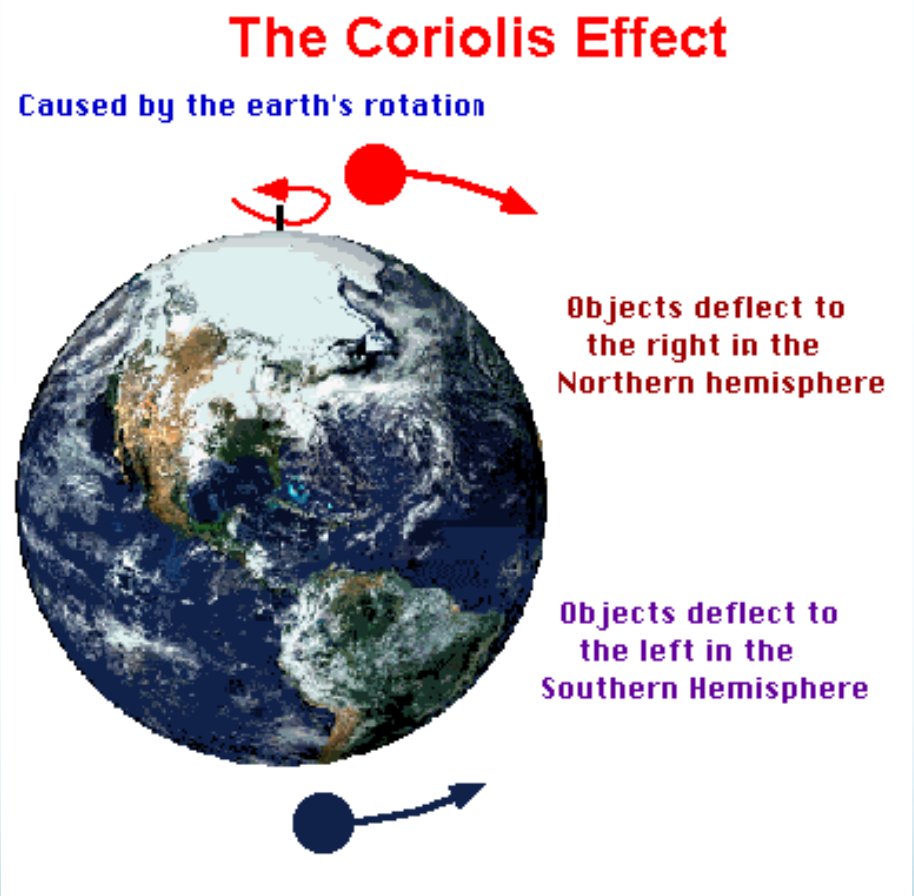

10 cm/s
-120
-80
-40
0
40
80
No Valid Data
Ocean Dynamic Topography (cm) Sep 23, 1992 - Sep 24, 1993

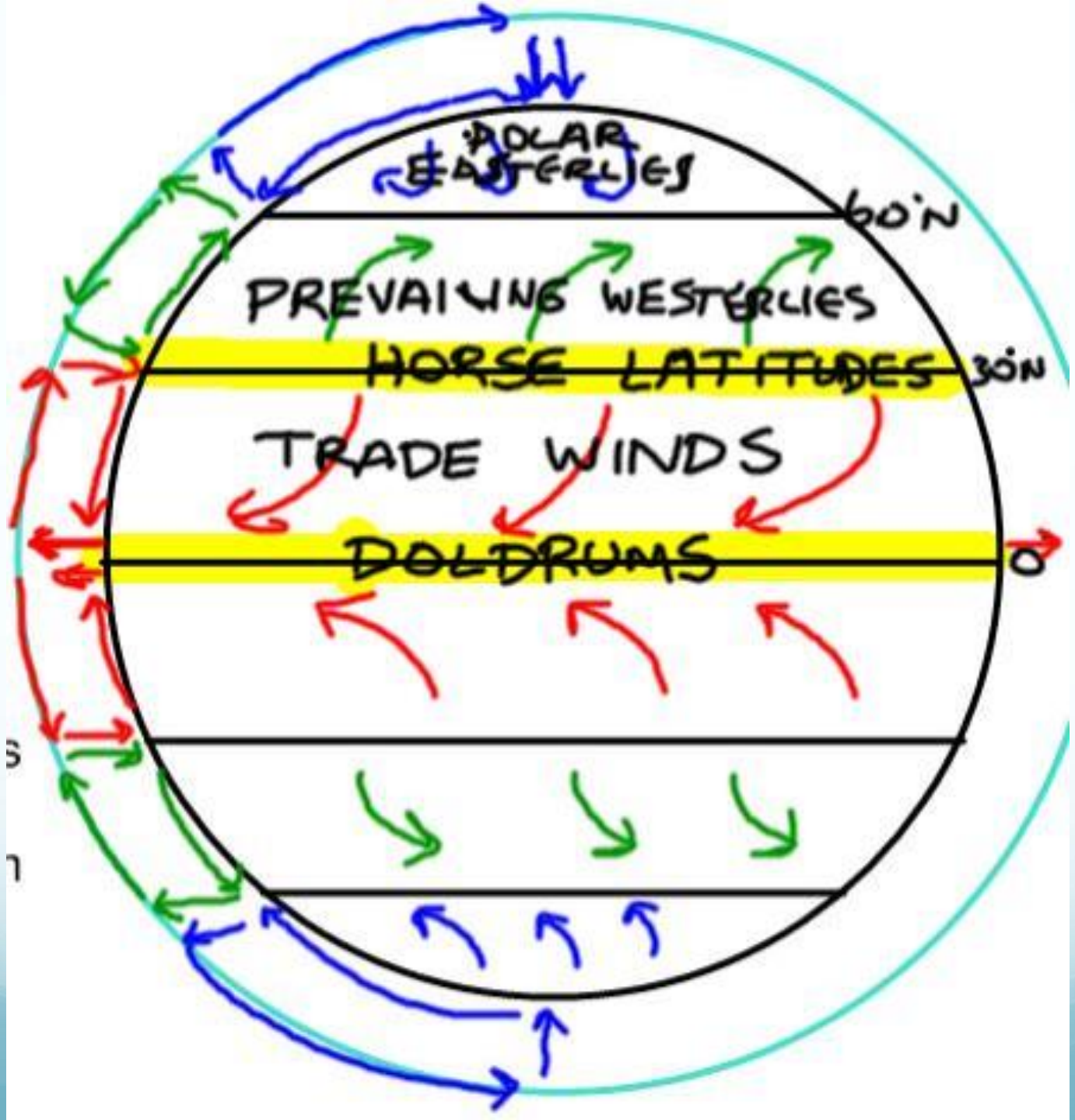
# Surface Currents

Controlled by 3 factors:

1. Global winds
2. Coriolis effect - curving of moving objects from a straight path due to the rotation of the Earth.
   - Northern Hemisphere turn clockwise.
   - Southern Hemisphere turn counter clockwise.
3. Continental deflections

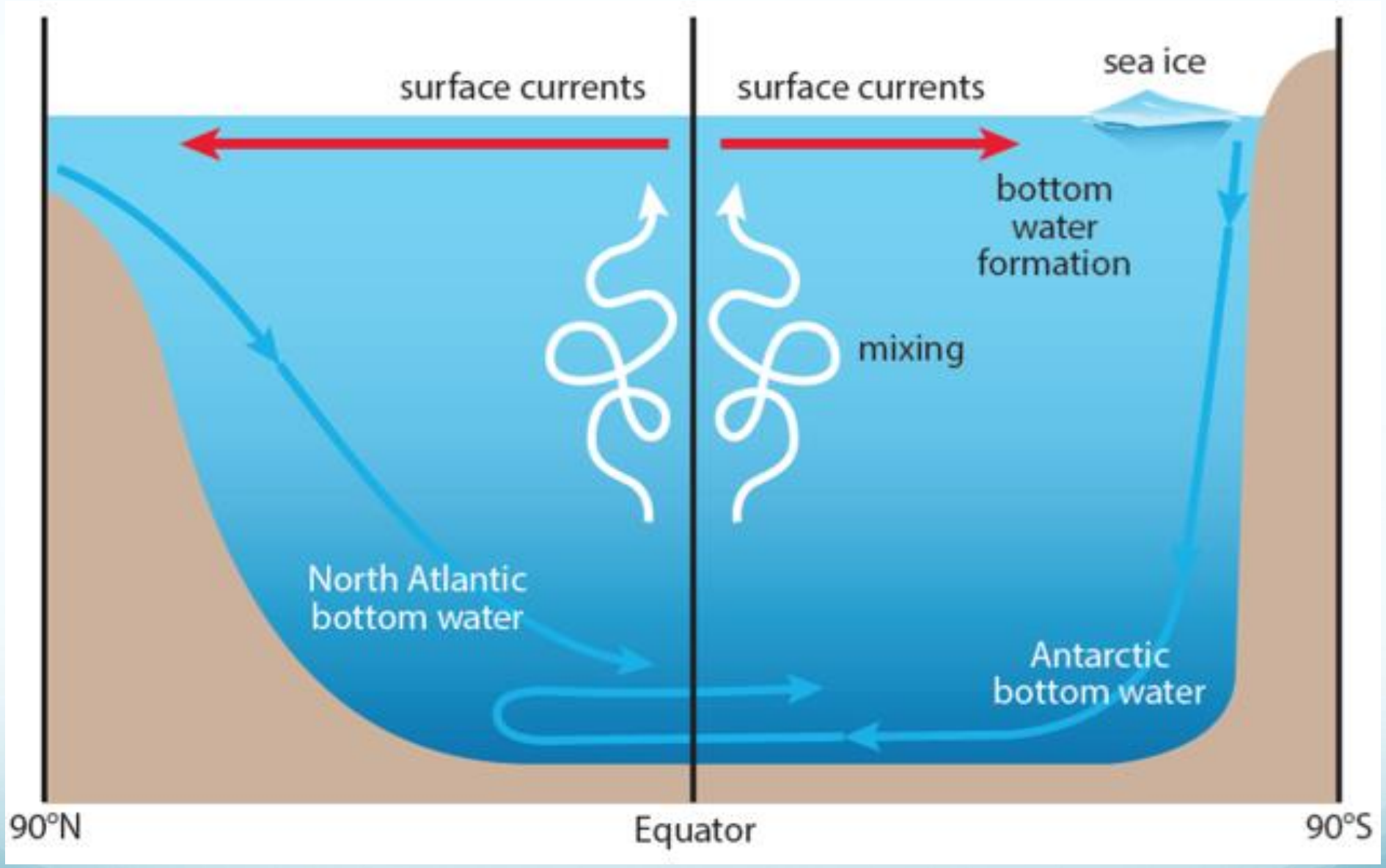
# Coriolis Effect


The Coriolis Effect
Caused by the earth's rotation
Objects deflect to the right in the Northern hemisphere
Objects deflect to the left in the Southern Hemisphere


POLAR EASTERLIES
60°N
PREVAILING WESTERLIES
HORSE LATITUDES
30°N
TRADE WINDS
DOLDRUMS
0

# Deep Water Currents

1. Happen far below the ocean surface
2. Carry cold, dense water along the ocean floor from polar regions to equatorial regions
3. Form in parts of the ocean where water density **increases**. Density increases by:
    a. Decrease water **temperature**
    b. ***Increased Salinity***-the amount of salt in the water




SF Fig. 2.11. Diagram showing equatorial upwelling and mixing of cool bottom water with warm surface water. Warm surface water is returned to poles through wind-driven surface currents. This is a very simplified model of water circulation in the Atlantic ocean basin.

**Image copyright and source**
Image by Byron Inouye

# Specific Heat Capacity of Our Oceans

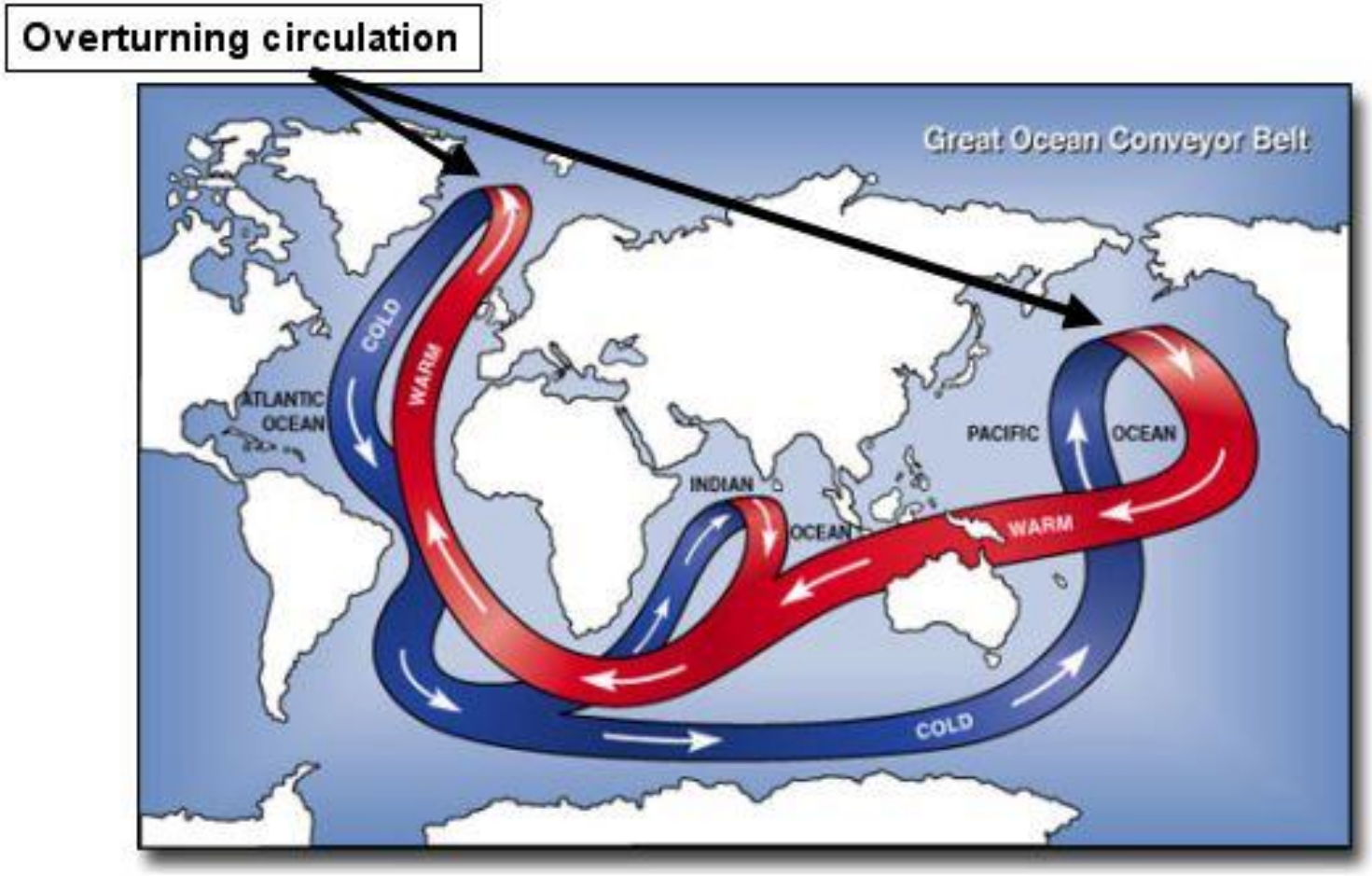
1. Ocean water has a **high specific heat capacity-** amount of energy needed to change its temperature
    a. It takes far **more energy** to change the temperature of water than land or air
    b. Water cools down & warms up slowly
2. This keeps coastal areas cooler in the summer and warmer in the winter.

# How Currents Trade Places

1. Heat is transferred by convection currents, continually moving from deep currents to surface currents
2. Water from deep currents (**COLD**) gets warmer as it **nears the equator** and begins to **rise** because it is warm.
3. Water from surface currents (**WARM**) get colder as they reach **the poles** and starts to sink because it is getting cold.

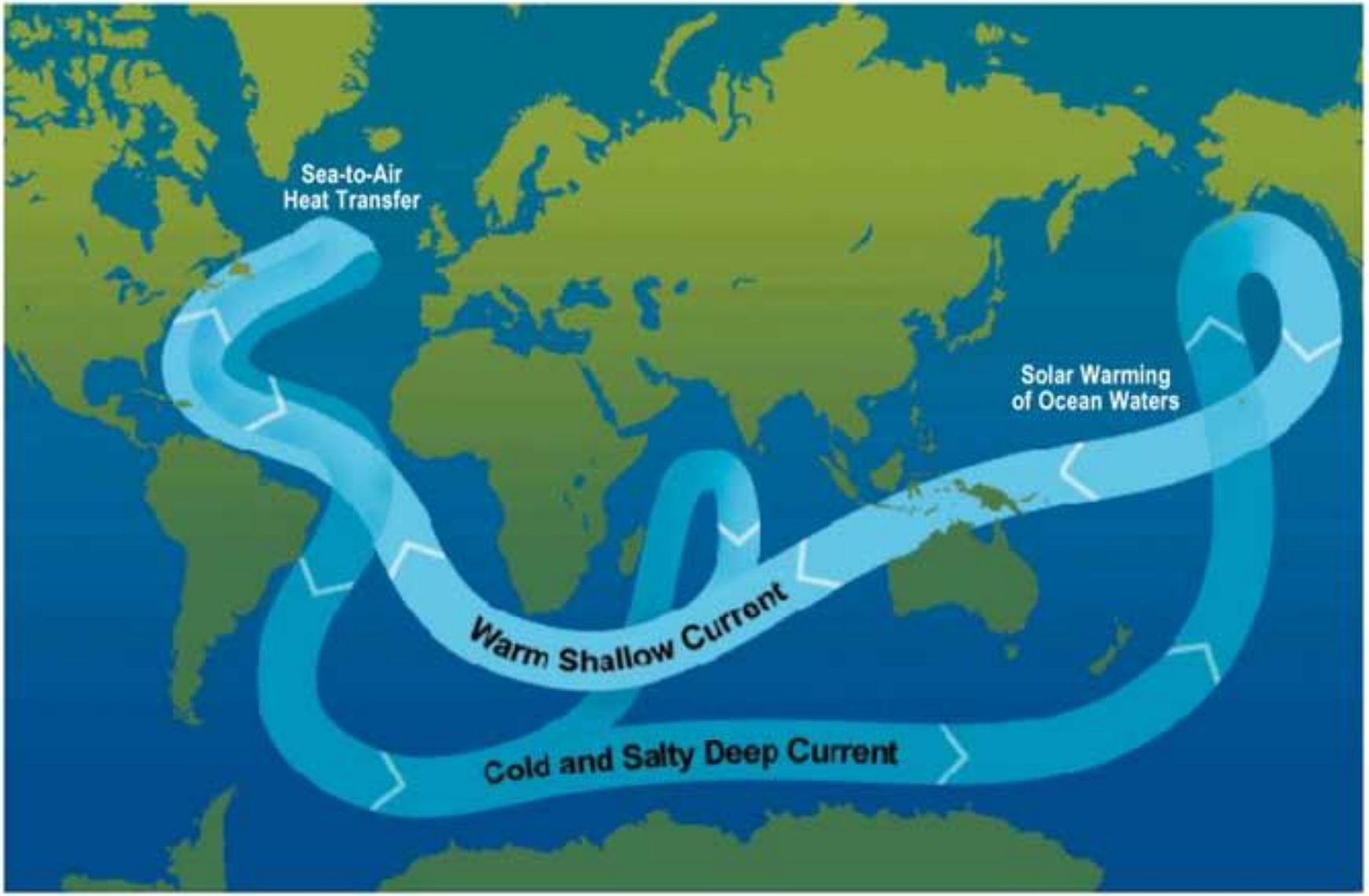
# Oceanic Conveyor Belt of Heat

## A conceptual model of global ocean circulation.

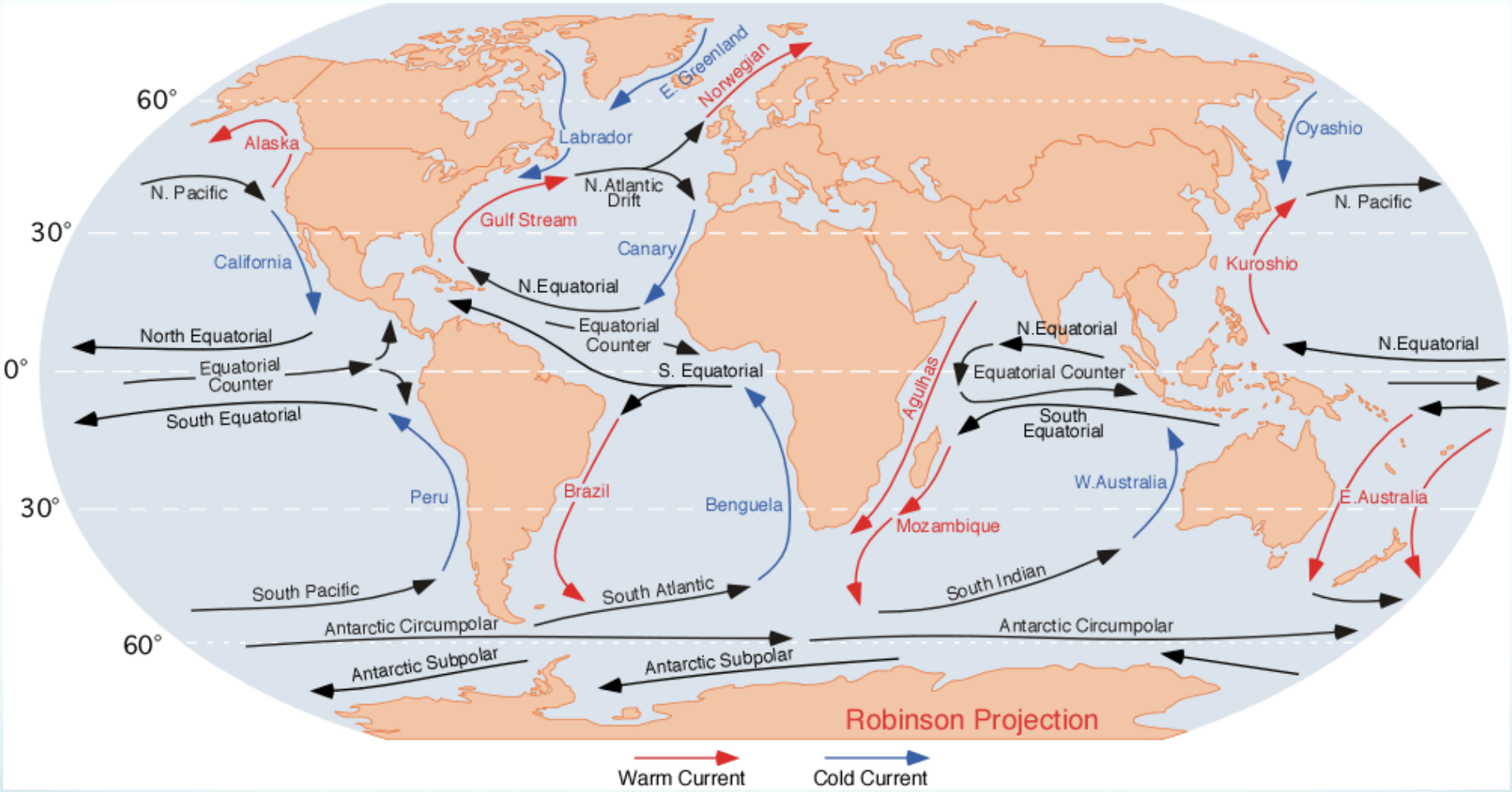



W.Broecker (Columbia U.); http://www.anl.gov/Media_Center/Frontiers/2003/

**Ocean Circulation Conveyor Belt**




The ocean plays a major role in the distribution of the planet's heat through deep sea circulation. This simplified illustration shows this "conveyor belt" circulation which is driven by differences in heat and salinity. Records of past climate suggest that there is some chance that this circulation could be altered by the changes projected in many climate models, with impacts to climate throughout lands bordering the North Atlantic.




Look at the ocean current diagram and answer the following questions with a partner:

1. Would you rather swim on the East or West side of Australia—why?
2. The Gulf Stream originates in the Gulf of Mexico. Predict what type of climate Ireland has in northern Europe because of this?